Notice of Allowability

Application No.	Applicant(s)	
08/857,836	J. Frederick Larrick, Jr. et al.	
Examiner	**Group Art Unit**	
Chieh M. Fan	2734	

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance and Issue Fee Due or other appropriate communication will be mailed in due course.

☒ This communication is responsive to *the amendment filed on 7/15/99*

☒ The allowed claim(s) is/are *1-30, 34, and 36-38 and they have been renumbered.*

☐ The drawings filed on ________________ are acceptable.

☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

☐ All ☐ Some* ☐ None of the CERTIFIED copies of the priority documents have been

☐ received.

☐ received in Application No. (Series Code/Serial Number) ________________ .

☐ received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

*Certified copies not received: ________________________________ .

☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

A SHORTENED STATUTORY PERIOD FOR RESPONSE to comply with the requirements noted below is set to EXPIRE **THREE MONTHS** FROM THE "DATE MAILED" of this Office action. Failure to timely comply will result in ABANDONMENT of this application. Extensions of time may be obtained under the provisions of 37 CFR 1.136(a).

☐ Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL APPLICATION, PTO-152, which discloses that the oath or declaration is deficient. A SUBSTITUTE OATH OR DECLARATION IS REQUIRED.

☒ Applicant MUST submit NEW FORMAL DRAWINGS

☐ because the originally filed drawings were declared by applicant to be informal.

☒ including changes required by the Notice of Draftsperson's Patent Drawing Review, PTO-948, attached hereto or to Paper No. 3 .

☐ including changes required by the proposed drawing correction filed on ________________ , which has been approved by the examiner.

☐ including changes required by the attached Examiner's Amendment/Comment.

Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the reverse side of the drawings. The drawings should be filed as a separate paper with a transmittal lettter addressed to the Official Draftsperson.

☐ Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Any response to this letter should include, in the upper right hand corner, the APPLICATION NUMBER (SERIES CODE/SERIAL NUMBER). If applicant has received a Notice of Allowance and Issue Fee Due, the ISSUE BATCH NUMBER and DATE of the NOTICE OF ALLOWANCE should also be included.

Attachment(s)

☐ Notice of References Cited, PTO-892

☐ Information Disclosure Statement(s), PTO-1449, Paper No(s). ________

☐ Notice of Draftsperson's Patent Drawing Review, PTO-948

☐ Notice of Informal Patent Application, PTO-152

☐ Interview Summary, PTO-413

☒ Examiner's Amendment/Comment

☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material

☒ Examiner's Statement of Reasons for Allowance

DETAILED ACTION

Examiner's Amendment

1. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Richard Sterba on 9/22/99.

2. The application has been amended as follows:

IN THE CLAIMS:

In Claim 29, page 30, line 26, "claim 27" has been changed to -----claim 28-----.

None of the prior arts teaches or suggests, alone, or in a combination, that a transmitter for radiating representations of ultra-wideband signals comprises of a switched impulse generator to generate a series of high-speed low-level ultra-wideband pulses, and a waveform adapter responsive to the low-level ultra-wideband pulses. The waveform adapter includes a filter that defines the center frequency and bandwidth of the low-level ultra-wideband pulses. Furthermore, no prior art teaches that a generated (time-gated) ultra-wideband signal is coupled to an amplifier before it is transmitted from an antenna.

Conclusion

5. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Chieh M. Fan whose telephone number is (703) 305-0198. The examiner can normally be reached on Monday through Friday from 8:30 a.m. to 5:00 p.m. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Stephen Chin, can be reached on (703) 305-4714.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 305-3900.

Any response to this action should be mailed to:

Commissioner of Patents and Trademarks
Washington, D.C. 20231

or faxed to:

(703) 308-9051 (for formal communications intended for entry)

Or:

(703) 308-6743 (for informal or draft communications, please label "PROPOSED" or "DRAFT")

Hand-delivered responses should be brought to Crystal Park II, 2121 Crystal Drive, Arlington. VA., Sixth Floor (Receptionist).

Chieh M. Fan
September 22, 1999 CF

STEPHEN CHIN
SUPERVISORY PATENT EXAMINER
GROUP 2700

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re PATENT APPLICATION of:

Larrick, et al.

Serial No.: 08/857,836

Group Art Unit: 2734

Filed: May 26, 1997

Examiners: Chieh M. Fan
Stephen Chin

For: WAVEFORM ADAPTIVE
ULTRA WIDEBAND TRANSMITTER
(Amended)

May 17, 1999

AMENDMENT

(Request for Automatic One-Month Extension)

Commissioner of Patent
and Trademarks
Washington, D.C. 20231

Sir:

Applicants respectfully request an automatic one-month extension of time and authorize charges therefor to Kile McIntrye & Harbin deposit account no. 06-0115.

In reply to the Office Action mailed January 27, 1999 (paper no. 3), please amend the above-identified application as follows:

IN THE TITLE

Change the title to --WAVEFORM ADAPTIVE ULTRA-WIDEBAND TRANSMITTER--.

IN THE SPECIFICATION

Page 5, line 7, before "UWB", delete "an" and insert --a waveform adaptive or carrier-controlled--; and

lines 7-8, delete "an adjustable" and insert --a controlled--.

Page 6, line 21, after "techniques," insert --one aspect of--.

Page 8, line 9, change "which" to --that--; and

line 11, change "the" (first occurrence) to --a--.

Page 10, line 2, change "Two" to --Without limitation of the invention, two--;

line 11, delete "All microwave" and insert --Microwave--; and

line 12, delete "are" and insert --may be--.

Page 11, line 31, delete "102".

Page 14, line 20, after "chain" delete "140, 142" and insert --of amplifier 160--; and

line 21, after "amplifiers" delete "140, 142".

Page 15, line 2, before "MMIC" insert --an--, and after "chain", delete "140, 142".

Page 18, line 30, before "excite" insert --directly--.

Page 23, line 28, after "logic.", insert --For the sake of convenient reference, the circuits and methods for altering, conditioning, adapting, filtering, pulse shaping, and/or controlling a low-level UWB pulses or impulse sources, including the setting, regulating or controlling of bandwidth, frequency, phase, multi-level attenuation/amplitude, etc., are herein referred to as waveform adapting or adaptation, or performed by a waveform adapter.--

IN THE CLAIMS

Cancel claims 31, 32, 33, and 35 without prejudice or disclaimer.

Rewrite claims 1-4, 6-7, 10, 12-13, 15-24, 26, 27, 28, 30, 34, and 36-37 as follows:

1. (Amended) [An ultra-wideband] A transmitter that radiates representations of ultra-wide band signals, said transmitter comprising:

a [signal] switched impulse generator to generate [an] a series of high-speed low-level ultra-wideband [signal having a selectable carrier frequency] pulses;

a waveform adapter responsive to said low-level ultra-wideband pulses, said waveform adapter including a filter that defines a center frequency of said low-level pulses; and

an antenna responsive to said [signal generator] waveform adapter to radiate representations of said ultra-wideband signals.

2. (Amended) The [ultra-wideband] transmitter according to claim 1, wherein:

said [signal generator generates an ultra-wideband signal having a selectable bandwidth] waveform adapter further defines a bandwidth of said low-level pulses.

3. (Amended) [The] An ultra-wideband transmitter [according to claim 2, wherein said signal generator comprises:] comprising a signal generator that generates an ultra-wideband signal having a selectable center frequency and bandwidth, an antenna responsive to said signal generator to radiate representations of said ultra-wideband signals, said generator comprising:

an oscillator;

a low-level impulse generator to generate a low-level impulse signal to gate an output of said oscillator;

a mixer having an RF port input receiving said output of said oscillator and having an X port input receiving an output of said low-level impulse generator; and

an amplifier to amplify a signal output from said mixer to an amplified-level [ultra-wideband] signal for transmission;

said amplified-level [ultra-wideband] signal having a center frequency and a bandwidth based on at least one characteristic of said oscillator.

4. (Amended) [The] <u>An</u> ultra-wideband transmitter [according to claim 2, wherein said signal generator comprises:] <u>comprising a signal generator that generates an ultra-wideband signal having a selectable center frequency, an antenna responsive to said signal generator to radiate representations of said ultra-wideband signals, said signal generator generates an ultra-wideband signal having a selectable bandwidth and comprises:</u>

an oscillator;

a low-level impulse generator to generate a low-level impulse signal to gate an output of said oscillator;

a filter to be impulse-excited by said low-level impulse signal;

a buffer amplifier to amplify a signal output from said filter;

a mixer having an RF port input receiving said output of said oscillator and having an X port input receiving an output of said buffer amplifier;

a bandpass filter to filter an ultra-wideband output from said mixer prior to transmission of said ultra-wideband signal; and

an amplifier to amplify a signal output from said bandpass filter to an amplified-level [ultra-wideband] signal for transmission;

said amplified-level [ultra-wideband] signal having a center frequency and a bandwidth based on at least one characteristic of said oscillator and at least one characteristic of said filter.

6. (Amended) The ultra-wideband transmitter according to claim 4, wherein:

said oscillator is a voltage controlled oscillator; <u>and</u>

a frequency of said oscillator being selectable between a plurality of frequencies to [affect] <u>effect</u> frequency hopping of said ultra-wideband transmitter.

7. (Amended) The ultra-wideband transmitter according to claim 4, wherein: power to said amplifier is gated [corresponding a to] <u>in synchronization with</u> timing of said signal output from said filter.

10. (Amended) [The] <u>An</u> ultra-wideband transmitter [according to claim 2, wherein said signal generator comprises:] <u>comprising a signal generator that generates an ultra-wideband signal having a selectable center frequency and bandwidth, an antenna responsive to said signal generator to radiate representations of said ultra-wideband signals, said signal generator comprising:</u>

an oscillator;

a low-level impulse generator to generate a low-level impulse signal to gate an output of said oscillator;

a voltage-controlled buffer amplifier to amplify a signal output from said low-level impulse generator;

a mixer having an RF port input receiving said output of said oscillator and having an X port input receiving an output of said buffer amplifier;

a bandpass filter to filter an ultra-wideband output from said mixer prior to transmission of said ultra-wideband signal; and

an amplifier to amplify a signal output from said bandpass filter to an amplified-level [ultra-wideband] signal for transmission;

said amplified-level [ultra-wideband] signal having a center frequency based on at least one characteristic of said oscillator and having a bandwidth based on at least one characteristic of said low-level impulse signal and a control voltage to said voltage-controlled buffer amplifier.

12. (Amended) The ultra-wideband transmitter according to claim 10, wherein:

said oscillator is a voltage controlled oscillator; <u>and</u>

said frequency of said oscillator being selectable between a plurality of frequencies to affect frequency hopping of said ultra-wideband transmitter.

13. (Amended) The ultra-wideband transmitter according to claim 10, wherein:

power to said amplifier is gated [corresponding] <u>according</u> to [a] timing of said signal output from said filter.

15. The ultra-wideband transmitter according to claim [10] 14, wherein:

said data is encoded at a rate in excess of 100 megabits per second.

16. (Amended) [The ultra-wideband] A transmitter [according to claim 2, wherein said signal generator comprises] that radiates representations of ultra-wide band signals comprising:

an oscillator to generate a low-level signal; [and]

a time gate to gate a [small] several nanosecond to sub-nanosecond range time portion of an output of said oscillator[, and to output an ultra-wideband signal] thereby to produce low-level time-gated ultra-wide band signal;

said [ultra-wideband signal] time-gated ultra-wide band signal having a center frequency corresponding to a frequency of said oscillator;

an amplifier responsive to said time-gated ultra-wide band signal to produce an amplified output; and

an antenna responsive to said amplified output to radiate representations of said ultra-wide band signals.

17. (Amended) The [ultra-wideband] transmitter according to claim 16, wherein said time gate comprises:

a [switch] a pair of serially connected successively fired on-off and off-on transistor switches to gate said small time portion of said output of said oscillator.

18. (Amended) The [ultra-wideband] transmitter according to claim 16, wherein:

said [ultra-wideband] time-gated ultra-wide band signal has a bandwidth based on a pulse width of said gated [small] time portion of said output of said oscillator.

19. (Amended) The [ultra-wideband] transmitter according to claim 18, wherein:

said bandwidth of said [ultra-wideband] time-gated oscillator signal is inversely proportional to said pulse width of said gated [small] time portion of said output of said oscillator.

20. (Amended) The [ultra-wideband] transmitter according to claim 16, wherein:

said oscillator [is] comprises a voltage controlled oscillator; and

said frequency of said oscillator is alterable between a plurality of frequencies to affect frequency hopping of said ultra-wideband transmitter.

21. (Amended) The [ultra-wideband] transmitter according to claim 16, wherein:

power to said amplifier is gated corresponding to a timing of said gated small time portion of said [output of said oscillator] time-gated oscillator signal.

22. (Amended) The [ultra-wideband] transmitter according to claim 16, further comprising:

a data encoder adapted and arranged to encode data in said [ultra-wideband] time-gated oscillator signal.

23. (Amended) The ultra-wideband transmitter according to claim [16] 22, wherein:

said data is encoded at a rate in excess of 100 megabits per second.

24. (Amended) A method of radiating representations of an ultra-wideband signal having a [carrier] desired center frequency, said method comprising:

generating a low-level signal having a frequency corresponding to a desired [carrier] center frequency of said ultra-wideband signal; [and]

[low-level] impulse-gating said low-level signal to generate a [low-level] series of discrete ultra-wideband [signal] pulses, said impulse-gating being less than about 5 nanoseconds;

waveform adapting said discrete pulses to produce a waveform-adapted output; and

applying said waveform-adapted output to an antenna to radiate representations of ultra-wide band signals.

26. (Amended) The method of generating an ultra-wideband signal having a [carrier] center frequency according to claim 24, further comprising:

after said impulse-gating step, amplifying said ultra-wideband [signal] pulses to a desired power level; and

radiating said amplified [ultra-wideband] [signal] pulses at said carrier frequency.

27. The method of generating an ultra-wideband signal having a [carrier] center frequency according to claim 24, further comprising:

adjusting on a pulse-by-pulse basis said frequency of said signal.

28. (Amended) A method of generating an ultra-wideband signal having a [carrier] center frequency, comprising:

generating a source signal having a frequency corresponding to a desired [carrier] center frequency of said ultra-wideband signal; [and]

time-gating said source signal to generate [an] a series of discrete [ultra-wideband signal] pulses, said time-gating being less than about 5 nanoseconds;

waveform adapting said series of discrete pulses to produce a waveform-adapted output whose frequency or bandwidth is determined by at least one of filtering, mixing, multi-level attenuating, and pulse-shaping said source signal; and

applying said waveform-adapted output to an antenna.

30. (Amended) The method of generating an ultra-wideband signal having a [carrier] center frequency according to claim [27] 28, further comprising:

amplifying said ultra-wideband signal to produce an amplified ultra-wideband signal of a desired power level; and

radiating said amplified ultra-wideband signal at said [carrier] center frequency.

34. (Amended) A signaling device including [an ultra-wideband] transmitter, said signaling device comprising:

a [signal] switched impulse generator to generate [an] a series of discrete low-level ultra-wideband pulses [signal having a selectable carrier frequency; and]

a waveform adapter responsive to said low-level ultra-wideband pulses that defines a center frequency and bandwidth of said ultra-wide band pulses;

said center frequency being determined by one of frequency-mixing and filtering said ultra-wide band signal; and

an antenna responsive to said [signal generator] waveform adapter to radiate a representation of said ultra-wideband signal.

36. (Amended) A method for transmitting data using ultra-wideband techniques, said method comprising:

generating [an ultra-wideband signal that includes] a series of UWB signal pulses by using one of an UWB impulse generator and a pulse-excited oscillator;

providing a data encoder to modulate said series of UWB signal pulses;

[modulating] providing a waveform adapter to modulate said series of signal pulses with said data encoder wherein said modulating comprises at least one of inter-pulse frequency variation, inter-pulse phase shifting and multi-level attenuation according to representations of data, said modulating being achieved by waveform adapting said signal pulses by controlling one of phase, bandwidth, frequency, amplitude, and attenuation;

applying said modulated signal pulses to an antenna; and

transmitting said modulated pulses at a selectable center frequency.

37. An ultra-wideband transmitter comprising:

a signal generator to generate an ultra-wideband signal having a selectable [carrier] center frequency, said signal generator comprising:

a low-level impulse generator to generate a low-level impulse signal,

a filter to be impulse-excited by said low-level impulse signal, and

an amplifier to amplify a signal output from said filter to an amplified-level [ultra-wideband] signal for transmission, a center frequency and a bandwidth of said amplified-level [ultra-wideband] signal being selectable based on at least one characteristic of said filter; and

an antenna responsive to said signal generator to radiate <u>representations of said</u> ultra-wideband signals.

REMARKS

Applicants appreciate the examiner's allowance of claims 37-38[1], and the indication of allowability of claims 3-15, 17, 20-23, 26 and 30 if rewritten in independent form to include limitations of base and intervening claims. These latter claims were amended to incorporate elements of interceding and base claims, in most respects. Certain recitals were re-worded. Thus, we believe claims 3-15, 17, 20-23, 26, 30, and 37-38 are now in condition for allowance.

To support allowability of the claims that the examiner initially rejected applicants submit a declaration of nonobviousness. Because relatively few UWB researchers exist in the field and the published literature on UWB signal processing is scarce, applicants felt it necessary to provide the examiner the benefit of Dr. Fontana's twenty-seven years of experience. This should help guide the examiner's assessment of allowability of the pending claims.

Also, a new **ABSTRACT** is being submitted herewith.

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[1] Minor editorial changes were made to claims 37-38.

Informalities and Other Comments

Drawing informalities noted by the examiner were addressed by deleting references to elements 140 and 142 at pages 14-15 of the specification. Such elements form part of an off-the-shelf MMIC amplifier that is commercially available from Stanford Microdevices, part no. SNA-586, recited in the specification.

Claim 23 was amended to depend from claim 22, instead of claim 16, as the examiner requested.

Claim 29 was amended to depend from claim 28, claim 30 was amended to become independent and claim 31 was cancelled.

The title was changed to reflect an invention being broader than merely a "frequency-adaptive" UWB transmitter. Waveform adapting includes regulating, controlling and/or setting frequency, phase, bandwidth, multi-level amplitude, multi-level attenuation, or other waveform properties but excludes the sole act of "pulse sharpening" as practiced by the prior art.

Objected claims 16-23 remain for consideration, but in view of amendments to independent claims 1 and 2, as explained below, we believe these too should now be allowable.

It should also be noted that the definition of ultra-wideband as used in the claims embraces wideband transmissions since the width of a pulse originating at an UWB source may spread in the time domain due to signal processing, pulse shaping or filtering. Upon transmission of a resulting signal by a radiating antenna, the actual transmitted pulse may become wideband, spanning several tens to hundreds of megahertz. Further, it should be noted that the definition of UWB in the industry (i.e., ratio of spectrum occupied above 3db skirt level in relation to the center frequency being less than 25%) has not yet achieved common acceptance among

industry groups. Reference is made in the present application and claims to "center frequency" or "carrier frequency" of an UWB signal. This is generally viewed as that central point of the spectrum occupied by the UWB pulse even though by many definitions in the art an UWB signal is "carrier free." Thus, these various definitions of should not be used to limit the scope of the present claims.

Rejection Under 35 USC Sec. 112, First Paragraph

Applicants have cancelled claims 32, 33, and 35 without prejudice or disclaimer. Instead, these as well as other subject matter disclosed in the application will be pursued in a continuation application. Applicants do not intend to dedicate to the public any unclaimed subject matter or any part of the disclosure. For the record, though, applicants believe that, taken with the disclosure of the subject application, mentioning of a communication system amounts to an inherent disclosure of a "receiver."

Rejection Under 35 USC Sec. 103(a) - McEwan and Tang et al.

The examiner rejected claims 1, 2, 16, 18, 19, 24-25, 28-29 and 32-35 under 35 USC Sec. 103(a) as being unpatentable over McEwan ('600)[2] in view of Tang et al. ('616). Comments made in this section are limited to claims 1, 2, 16, 18, 19, 24-25, 28-29 and 32-35 and do not apply to other claims.

As clearly recited by amended claims 1-2, 24, 28 and 34 the invention includes a switched impulse generator, a waveform adapter, and an antenna. Waveform adapting does not include pulse sharpening, as prevalent in the prior art. See Fontana Decl., ¶ 14. Claim 2 additionally includes defining a

[2] McEwan was initially cited by applicants in their Information Disclosure Statement.

bandwidth of the generated signal. In sum, the structure of claims 1 and 2 is believe patentable because, among other things, the prior art teaches away from interposing any form of waveform adapting (exclusive of pulse sharpening) and/or filtering between a UWB signal source and a transmitting antenna. See Fontana Decl., ¶¶ 4 and 7-10.

McEwan describes "proximity detection" using a gated oscillator. Tang et al. describe a continuous wave radar and specifically teaches away from using switched UWB sources. Neither of these references teaches or suggests use of a *switched, impulse-generated* UWB signal source to generate pulses that are controlled in center frequency, phase, bandwidth, and/or amplitude by waveform-adapting the output of a low-level UWB source comprising either an impulse-excited oscillator or an UWB impulse-generator wherein a "waveform-adapted" low-level signal output is applied to a radiating antenna. In fact, Tang et al. teaches to "avoid" switching and McEwan (as well as the prior art) teaches to apply a low-level signal "directly" to an antenna, rather than to an intermediate waveform adapter which, in turn, supplies an antenna (or an amplifier as recited in some of the claims).

Based on his experience, qualifications, analysis, and assessment of the state of the art set forth in **¶¶ 1-20** of his declaration (attached) Dr. Fontana has detailed reasons why this structure is allowable.

Further, McEwan's system functions to detect an object when the minimum pulse width spans twice the time-of-flight distance between the object and transceiver. This suggests the lack of time-wise discrete pulses. Further, Tang et al. teach away from switched or impulse-generated UWB sources, stating in their Abstract that "a pulse train is formed [from]

individual spectral components ... without switching a radio frequency signal." See lines 1-5.

Thus, the teachings of McEwan and Tang, et al. appear to be inconsistent because there's no suggestion in Tang et al. to use selection or control of frequency, bandwidth, phase, multi-level attenuation or amplitude, pulse shaping, etc. in a "switched" or "impulse-generated" UWB system that produces a series of discretely-generated pulses. See MPEP, Sec. 2142 (combining the teachings of separate references must be objectively suggested). A general statement that modification can be made to a primary reference without some "objective" reason inherent in the references or general knowledge in the art to combine them is believed insufficient to support an obviousness-type rejection. See MPEP Sec. 2143.01.

Pointing to more specific distinctions, amended claims 1, 24, 28 and 34 recite use of a "waveform adapter" or provide the step of "waveform adapting" that uses a low-level signal and/or that either uses or relates to processes of a bandpass filter, pulse shaper, or a multi-level attenuator for controlling frequency, pulse shape, bandwidth, phase, attenuation/amplitude, etc. The low-level signal may comprise a gated oscillator output or an impulse generated output.

The output of McEwan's gated oscillator 10, as shown in Fig. 1, is applied "directly" to an antenna without any intervening signal processing. Further, Tang et al. differ by using a "continuous wave" oscillator-generator combination 60, 61 to produce a signal having pulse characteristics, but not being gated, switched, or impulse-generated. Also, since McEwan senses object proximity within a predetermined range, he elongates pulse width to span at least twice the time-of-flight transceiver-to-object distance so that his receiver may compare frequency/phase differences between transmitted and

reflected signals. See col. 2, line 66 to col. 3. line 7. McEwan's system even becomes inoperative for sensing beyond that range.

As an additional reason why a rejection should not be applied against claims 1, 2, 16, 18, 19, 24-25, 28-29 or 32-35, nothing in McEwan[3] (or Tang et al. for that matter) seems to teach or suggest how to obtain short-pulse generation or timing control in the few nanosecond to sub-nanosecond range, such as sub-nanosecond gating circuitry, pulse shaping, etc. to produce a series of discrete UWB pulses. Applicants, on the other hand, disclose several embodiments of waveform adaptation of short pulses including, without limitation, a time-gating circuit (Fig. 4) that uses a delay line having sub-nanosecond taps (see p. 19, line 27 to p. 20, line 17), a digitally-controlled delay device (p. 20, line 14), and a programmable delay device (p. 21, lines 23-25), inter alia.

Tang et al. simply do not teach a "switched impulse" generator to generate pulses as recited in claims 1 and 34, or of method claims 24 and 28. They state, at col. 3, lines 46-49, that "[t]he spectral components [of the continuous wave signal] are not transmitted separately, one after the other in sequence. They are all transmitted together." As such, the combination of McEwan and Tang et al. fails to teach or suggest the inventions of claims 1, 24, 28 and 34, as amended.

In rejecting original claim 2, the examiner stated, at p. 4, para. 7, that McEwan, like applicants, appreciates that "bandwidth of the UWB signal can be adjusted by changing the pulse width." Because McEwan uses a "potentiometer" for manually adjusting pulse width, e.g., to set a detection range (see McEwan, col. 7, lines 15-18), we fail to see any

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[3] McEwan does, however, disclose an RC timing circuit, but his is subject to thermal instability,

suggestion of dynamic, real-time control, as contemplated by the invention of those claims now directed to frequency or bandwidth agility. Claim 2, though, does not include this limitation.

Accordingly, applicants request reconsideration and withdrawal of any rejection that might be applied against amended claims 1, 2, 24, 28 and 34, as well as those claims that depend therefrom.

Rejection Under 103(a) - McEwan, Tang et al. and Anderson

The examiner rejected claims 27, 31 and 36 under 35 USC Sec. 103(a) as being unpatentable over McEwan '600 in view of Tang et al. '616 as applied to claims 24 and 28, further in view of Anderson et al. '404. Anderson et al. were cited for disclosure of pulse-by-pulse frequency adjustment and modulation. Anderson et al., however, relate to a "microwave" system -- not the claimed UWB or short-pulse (e.g., wideband) systems or methods.[4] Nevertheless, claim 31 was cancelled without prejudice or disclaimer, so claims 27 and 36 remain for reconsideration on this issue.

Anderson et al. also depart from the inventions of claims 27 and 36 because they describe step-wise sweeping of frequency at discrete bands (col. 7, lines 66-74), but do not show "waveform adaptation" of a series of UWB signal pulses or "frequency adjustment on a pulse-to-pulse basis" in accordance with data-modulation.

As applicants explained in the present specification, other UWB modulation schemes have been limited to on-off keying (amplitude shift keying (ASK)) or pulse position modulation (PPM) (e.g., time-shifting). (See, for example,

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[4] See col. 6, lines 24-44. See also col. 8, lines 32-33 referring to one-microsecond pulses. This should be contrasted with pulse duration of a few nanoseconds to sub-nanosecond range of the present invention.

Time Modulated Ultra-Wideband Technology, by Time Domain Corporation, 1998, Attachment G). As data rates increase, and pulses become narrower and more closely spaced, e.g., in the nanosecond or sub-nanosecond range, pulse-by-pulse waveform adaptation for data modulation becomes extremely difficult to achieve. This is true even for conventional PPM and ASK modulation. Because the present invention provides tight timing control and/or waveform adaptation of impulse-generated or gated-oscillator produced UWB pulses, applicants were able to achieve modulation by non-traditional techniques, e.g., beyond ASK and PPM modulation, including pulse-by-pulse frequency, phase, bandwidth, phase shifting and multi-level attenuation/amplitude control.

Because Anderson et al., among other things, relate to a microwave system and disclose signals having stepwise increased frequency, which departs from "pulse-to-pulse" frequency agility (claim 27) and "inter-pulse" modulation in accordance with a data encoder (claim 36), we believe the rejection on the basis of McEwan, Tang et al., and Anderson et al. as applied against claims 27 and 36 should be withdrawn.

Conclusion

In view of the above, reconsideration and allowance of all pending claims are respectfully requested.

Please charge any costs, including the fees for the one-month extension of time and/or any extra claims fee to Kile McIntyre & Harbin deposit account no. 06-0115.

Respectfully submitted,
KILE McINTYRE & HARBIN

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ABSTRACT OF THE DISCLOSURE

A waveform adaptive transmitter that conditions and/or modulates the phase, frequency, bandwidth, amplitude and/or attenuation of ultra-wideband (UWB) pulses. The transmitter confines or band-limits UWB signals within spectral limits for use in communication, positioning, and/or radar applications. One embodiment comprises a low-level UWB source (e.g., an impulse generator or time-gated oscillator (fixed or voltage-controlled)), a waveform adapter (e.g., digital or analog filter, pulse shaper, and/or voltage variable attenuator), a power amplifier, and an antenna to radiate a band-limited and/or modulated UWB or wideband signals. In a special case where the oscillator has zero frequency and outputs a DC bias, a low-level impulse generator impulse-excites a bandpass filter to produce an UWB signal having an adjustable center frequency and desired bandwidth based on a characteristic of the filter. In another embodiment, a low-level impulse signal is approximated by a time-gated continuous-wave oscillator to produce an extremely wide bandwidth pulse with deterministic center frequency and bandwidth characteristics. The UWB signal may be modulated to carry multi-megabit per second digital data, or may be used in object detection or for ranging applications. Activation of the power amplifier may be time-gated in cadence with the UWB source thereby to reduce inter-pulse power consumption. The UWB transmitter is capable of extremely high pulse repetition frequencies (PRFs) and data rates in the hundreds of megabits per second or more, frequency agility on a pulse-to-pulse basis allowing frequency hopping if desired, and extensibility from below HF to millimeter wave frequencies.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re PATENT APPLICATION of:

Larrick, et al.

Serial No.: 08/857,836

Group Art Unit: 2734

Filed: May 26, 1997

Examiners: Chieh M. Fan
Stephen Chin

For: WAVEFORM ADAPTIVE
ULTRA WIDEBAND TRANSMITTER
(Amended)

May 14, 1999

Declaration of Robert J. Fontana, Ph.D.
(Non-Obviousness)

The undersigned inventor, Robert J. Fontana, Ph.D., in support of allowability of claims rejected in the referenced application (See Examiner's Official Action dated January 17, 1999), hereby declares as follows:

Qualifications

1. I earned a BSEE degree from the Illinois Institute of Technology in 1971 with a fellowship to study at the Institut National des Sciences Appliquées (Lyon, France) in 1969-70; a SMEE degree from the Massachusetts Institute of Technology in 1974; and a Ph.D. in Electrical Engineering form Stanford University in 1978. I served as Staff Engineer at Raytheon from 1971 to 1975; Assistant Professor of Electrical Engineering at Carnegie Mellon University from 1978 to 1981; Department Manager of Advanced Technology at Litton-Amecom from 1981 to 1984; and presently serve as President of Multispectral Solutions, Inc., assignee of the present application.

2. I have over 27 years of experience in areas including signal processing, high-speed digital design, microwave/RF circuit design, and ultra wideband technology. For the past 15 years I have been actively involved in the development of hardware and systems which utilize UWB transmission techniques.

3. I have authored or co-authored at least the following publications related to ultra wideband technology:

Fontana, R.J., "LPI/D Enhancements for Ultra Wideband," Invited Paper, U.S. Government Low Probability of Intercept Communications Committee (LPICC), National Reconnaissance Office, Chantilly, VA, 28 October 1998.

Fontana, R.J., "Ultra Wideband Communications," Invited Paper, DARPA Workshop on Ultra Wideband Systems and Technology, Lawrence Livermore National Labs, Livermore, CA, 11 June 1998.

Fontana, R.J., J.F. Larrick, J.E. Cade and E. Rivers, "An Ultra Wideband Sensor for Airborne Wire Detection," Proceedings AUVSI '98, Huntsville, AL, June 8-12,1998.

Fontana, R.J., "Update on Ultra Wideband Radio," Invited Paper, U.S. Government Low Probability of Intercept Communications Committee (LPICC), MacDill, AFB, Tampa, FL, 20 May 1998.

Fontana, R.J., J.F. Larrick, J.E. Cade and E. Rivers, "An Ultra Wideband Synthetic Vision Sensor for Airborne Wire Detection", Enhanced and Synthetic Vision 1998, Orlando, FL, April 1998.

Fontana, R.J., "A Novel Ultra Wideband (UWB) Communications System," Proc. MILCOM 97 (Classified), Monterey, CA, November 2-5, 1997.

Fontana, R.J., J. F. Larrick and J.E. Cade, "A Low Cost Ultra Wideband System for UAV Communications and High Resolution Radar Applications," Precision Strike Technology Symposium - 1997, Johns Hopkins University, Applied Physics Laboratory, October 8-9, 1997.

Fontana, R.J., "An Ultra Wideband Communication Link for Unmanned Vehicle Applications," Proceedings AUVSI '97, Baltimore, MD, June 3-6, 1997.

Fontana, R.J., "Update on Wideband Radio," Invited Paper, U.S. Government Low Probability of Intercept Communications Committee (LPICC), San Diego, CA, 24 January 1997.

Fontana, R.J., J.C. Koppier and R.W.T. Mulloy, "A Low Cost Ultra Wideband (UWB) Radar Altimeter," Proceedings AUVSI '96, Orlando, FL, July 15-19, 1996, pp. 297-301.

Ross, G., R. Price and R. J. Fontana, "The Suppression of Spectral Lines for Improved Covertness in Ultra Wideband (UWB) Transmissions," Proc. MILCOM 95, San Diego, CA, November 1995.

UWB Development History

4. An early impulse, or ultra wideband, transmitter was known as the Marx generator, first described in 1923, where storage elements (e.g., transmission lines or capacitors) were charged in parallel and subsequently discharged in series. Switching elements were simply spark gaps, in which the voltage breakdown of air or an inert gas was used for switch closing or triggering. In their discussion of UWB transmitters (in Chapter 4, *Transmitters*, in *Introduction to Ultra-Wideband Radar Systems*, ed. James D. Taylor, CRC Press, Inc., 1995), the authors indicate that the output of the Marx generator

"can be connected *directly* to antennas if the risetime matches the system requirements; otherwise, pulse-sharpening techniques can be applied" (italicized emphasis added). The authors do not describe generator output *filtering* for spectral *confinement*, but rather pulse-*sharpening* for spectral widening (or pulsewidth narrowing).

5. For pulse-sharpening, the output of the Marx generator was fed to a microwave diode (e.g., step recovery diode, plasma diode or avalanche diode) which was located *directly* at the antenna terminals (e.g., Gerald F. Ross, et al., U.S. Patent 5,216,695, June 1, 1993):

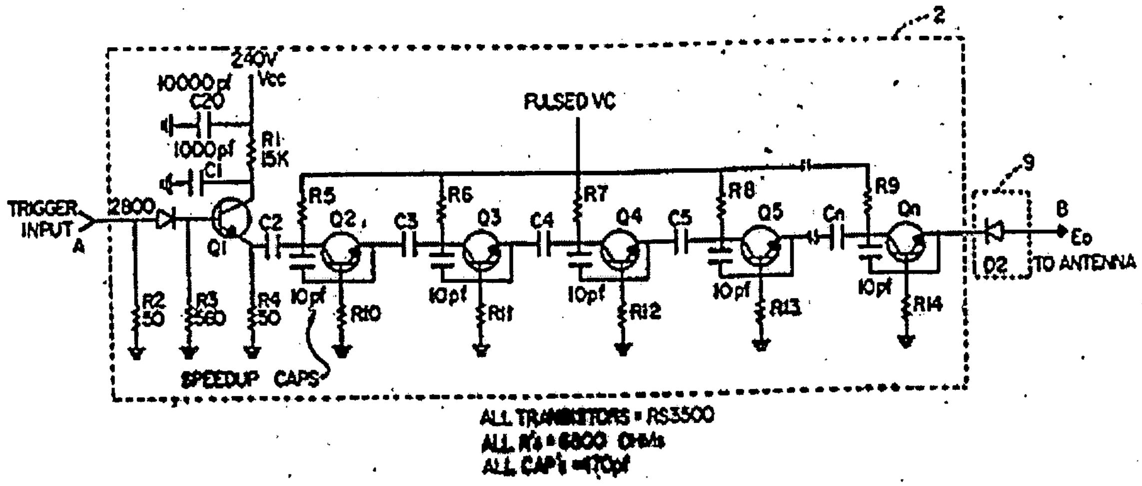


Figure 1. Diagram from Ross, U.S. Patent 5,216,695, June 1, 1993.

6. Alternative impulse sources were based on former Soviet technology in the early 1990's by PowerSpectra (Sunnyvale, CA). A low voltage version (PGS401) utilized a GaAs thyristor device to produce in excess of 350 Volts across a 50Ω load (2.45 kW) and was capable of sustaining a pulse repetition frequency (PRF) of up to 50 kHz. (The Ross Marx generator had a PRF limit of approximately 25 kHz.) A higher power device, the BASS™-01X, utilized a bulk avalanche semiconductor capable of producing over 5,000 peak volts into a 50 Ω load (500 kW). In both devices, pulse durations were typically less than 1-2 nanoseconds with pulse risetimes of less than 150 ps.

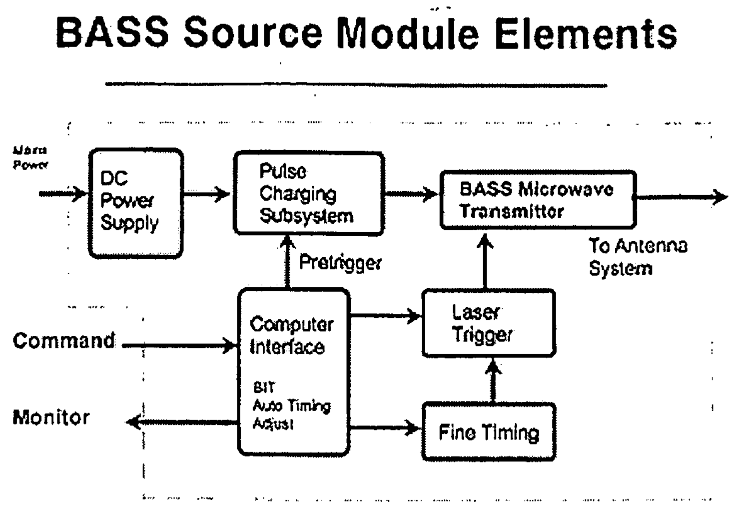


Figure 2. Drawing from PowerSpectra (Sunnyvale, CA) advertising promotion for Bulk Avalanche Semiconductor Switch (BASS) for UWB Transmitter.

7. As shown in Figure 2 above, the BASS was designed to operate *directly* into an antenna load instead of a power amplifier. In its documentation, PowerSpectra specified the use of either horns (rigid, rectangular or TEM) and/or biconical TEM mode antennas. In its documentation for the PGS401, the manufacturer indicated that applications for the device included ground penetrating radar, test equipment and signal transmitters. In ground penetration radar applications, the output of the device is again *directly* attached to a wideband antenna.

8. Until recently nearly all UWB research focused on developing megawatt impulse sources that were applied *directly* to an antenna. Fast risetime pulses having multiple kilowatt to megawatt power levels could only be achieved by sources whose pulse repetition frequencies were inherently limited to a few tens of kilohertz, making their use in high-speed communications applications very difficult. This is confirmed by Thomas McEwan in his invention disclosure (Attachment E(UCRL-JC-113207), March 1993, para. 11, p. 12), which is believed to have led to McEwan's U.S. 5,521,600 cited by the examiner. McEwan apparently directed his efforts to develop a micropower UWB signal generator (an impulse source and/or gated oscillator) with relatively high pulse repetition frequencies, and applied the low-power UWB output *directly* to an antenna without any intervening signal processing or waveform adaptation. (See Attachment E, p. 9, which provides that his system "differs from conventional radar in that a sub-nanosecond voltage pulse is applied *directly* to a broadband antenna."). To the best of my knowledge, UWB researchers in the past did not use amplifiers or signal processing elements, such as a filter, to further condition signals emanating from an UWB source.

9. Also to my knowledge, prior systems that produced UWB signals whether originating from a high power or micropower source applied the UWB signals *directly* to an antenna and did not include any intervening signal processing elements for waveform adaptation. I am, however, aware that 1996 trade literature (Attachment F, p. 6-15) indicates that researchers appreciated that work may be performed in the area of pulse shaping and signal processing, but I am not aware of any reduction-to-practice of UWB

systems that implemented any form of waveform adaptation, filtering, amplification, or other signal processing (except pulse sharpening) interposed between a UWB signal source and the radiating antenna.

10. Except for pulse sharpening, interposing any form of signal processing between a UWB signal source and a radiating antenna taught against conventional wisdom for several reasons including (1) a slowing of risetime of the UWB pulse applied to a radiating antenna, (2) potential pulse distortion that interferes with ability of conventional UWB pulse detectors to detect UWB signals, (3) a reduction in available power delivered to the radiating antenna and hence any UWB receiving circuits, or (4) introduction of band-limiting or filtering also reduces available power to the radiating antenna.

11. To explain further, I believe that artisans of even extraordinary skill did not direct UWB transmitter design towards generating low-level UWB impulse signals with subsequent amplification and/or additional pulse shaping (e.g., waveform adapting) for reasons including:

(a) UWB transmitter design was (and still is today in many cases) driven by the desire to have as wide a bandwidth as possible in order to produce the shortest possible pulse (for precision radar ranging applications) and the lowest power spectral density (i.e., watts per Hertz) for covert communications applications. Additional pulse *sharpening* diodes were used to further enhance these wide bandwidth properties. As an example, the UWB Ground Penetrating Radar community maintains the fidelity of the UWB pulse by using antennas which have the largest possible bandwidth so as to not distort the baseband pulse. Filtering is the antithesis of this process.

(b) In a document entitled "Assessment of Ultra-Wideband (UWB) Technology," prepared by the OSD/DARPA Ultra-Wideband Radar Review Panel and Battelle's Tactical technology Center (DTIC AD-B146160, July 13, 1990), the Executive Summary provides:

"Interest in UWB technology has focused on three areas:

- Radar
- Communications
- Electronic warfare (EW) and RF weaponization.

"The Panel concentrated on radar but invited the presentation of ideas on communications. No ideas or proposals for UWB communications systems or techniques were presented, nor were any advantages for such systems apparent to the panel."

Furthermore, it is my belief that UWB radar designers were interested in producing large peak output powers with as narrow a pulsewidth as possible. From a 1995 reference book on ultra wideband radar,

"In UWB impulse radars, the power supply output is applied *directly* to the antenna with perhaps an intermediate stage to sharpen the pulse. The voltage required starts in the thousands of volts and ranges to many megavolts. Because UWB radars emit a much shorter pulse than narrowband radars, they

must use higher voltages to produce similar pulse energies given similar antenna impedance levels."[1]

Since a panel of Government and industry experts in the field apparently saw no advantages to using UWB techniques for communications, this appears also true of a person of ordinary skill and also a person of extraordinary skill in the relevant fields of art. Also, I believe that the mindset of UWB designers was such that higher voltages were considered to be required to achieve the desired output powers since the UWB source was applied *directly* to the antenna.

Thus, there appeared to be no incentive to:

(i) extend the maximum pulse repetition rates of UWB sources to accommodate high speed (Mb/s) communications rates;

(ii) design low voltage UWB sources which could be used in UWB handheld radios, low power UWB tags, short range collision avoidance radars, manpack UWB geolocation equipment, etc.;

(iii) utilize filtering at the UWB transmitter since the UWB source needed to be connected directly to the antenna; or

(iv) utilize gated power amplifiers for waveform power amplification since only higher voltages were considered for pulse amplification.

(c) Even within the UWB communications field, persons skilled in the relevant fields of art seemed to consider only direct impulse excitation of an antenna with either high voltage, or high current (equivalent), impulse sources.

Most UWB transmitter designs utilize the nonlinear properties of avalanche or breakdown effect semiconductor devices to achieve a short pulse output. The resultant pulse output from any such device is a doubly-exponential pulse having a very fast rise time, and a slower decay time. From a mathematical analysis of this pulse shape, it can be shown that in order to achieve a higher peak power at a given frequency from such a pulse, it is necessary to either decrease the rise time of the pulse (fundamentally limited by device physics) or else increase the peak operating output voltage. Thus, the trend of development of UWB transmitter designers was to attempt to generate hundreds to thousands of volt pulses in order to provide the power necessary for a given application.

For example, in a 1984 Technical Memorandum entitled "Comments on Baseband or Carrier-Free Communications," prepared by ANRO Engineering Consultants, Inc., October 1, 1984, Dr. G. Ross illustrated a UWB transmitter design utilizing "a string of step recovery diodes connected within a microwave cavity. Thus, by changing the cavity (i.e., the antenna) and the diodes, one can place the spectrum of the transmitted signal almost anywhere in the L-X band region of the spectrum." This UWB transmitter generated a 350 volt peak waveform. In 1986, Dr. Fontana and Dr. Ross collaborated in the design of the first UWB transceiver which utilized this direct impulse excitation of an antenna. The transceiver operated at an apparent center frequency of 1,300 MHz (23 cm wavelength).

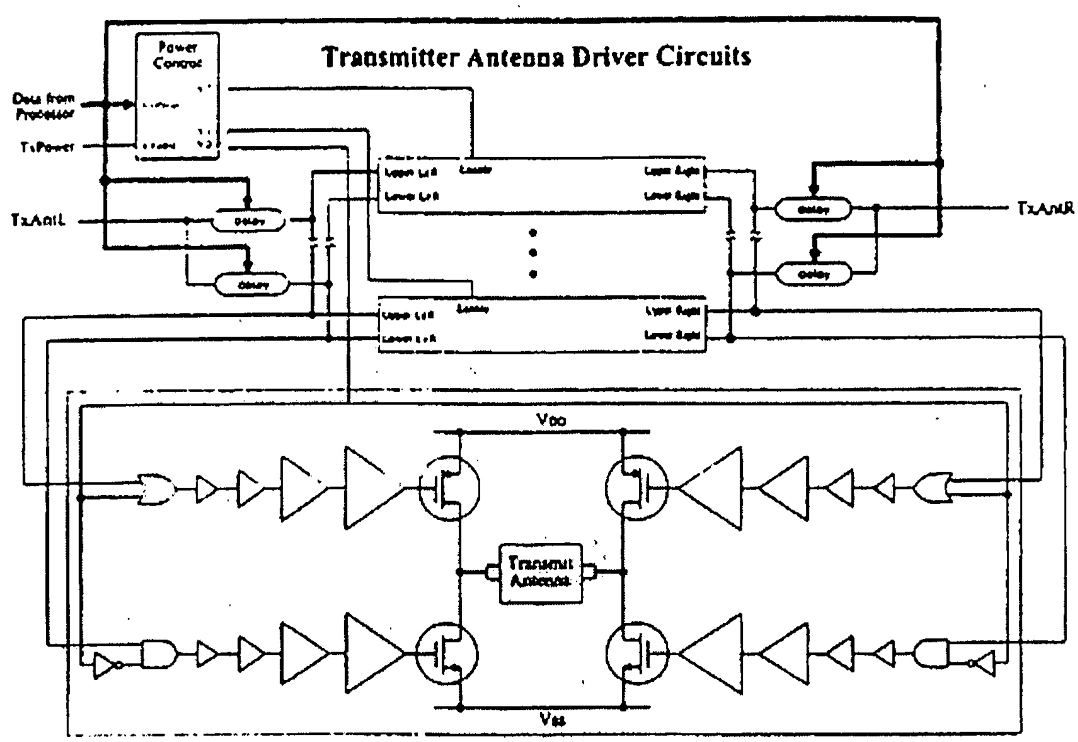
[1] "Introduction to Ultra-Wideband Radar Systems," ed. James D. Taylor, CRC Press, Boca Raton, FL, 1995, Chapter 4 *Transmitters*.

Later, in 1993, Dr. Fontana and Dr. Ross collaborated to design a UWB transceiver which utilized a Marx generator and a plasma diode (which replaced the string of step recovery diodes) to produce a 1,000 volt peak waveform. The plasma diode was literally soldered across the center terminals of the antenna – a broadband, cylindrical dipole having an electrical half wavelength of 12 cm (2,500 MHz). The higher voltage was needed to produce sufficient energy at this higher operating frequency.

Impulse devices from PowerSpectra (cf. 6. And 7. above) were developed in this same time frame. These devices utilized novel Soviet technology to produce impulse sources having between 350 and 5,000 volt peak outputs. Again, according to PowerSpectra marketing literature, these devices were promoted for ground penetrating radar applications in which the source was connected *directly* to a wideband antenna.

The use of high voltage, UWB sources forced UWB communications system designs to incorporate dual antennas – one designed for transmit only which contained the high voltage diode(s), and a second for receive only which contained no additional components. First attempts to utilize a single antenna made by MSSI in 1995 required the development of a fast, high voltage, low loss transmit/receive switch. Unfortunately, these high voltage T/R switches were quite costly to fabricate (~ $1500 per unit). Thus, in investigating alternative techniques for the generation and switching of high power UWB pulses, the applicants developed the techniques described in the current patent application.

Finally, here is a very recent example of the state-of-the-art in UWB transmitter design. In the recent Ultra Wideband Radio Workshop (May 25-28, 1998, The Alisal, Solvang, CA) sponsored by the U.S. Army Research Office and the Communications Science Institute of the University of Southern California, direct impulse excitation of an antenna was discussed by Dr. Robert Fleming, Aether Wire & Location. The figure below illustrates their UWB transmitter design in which a current-mode short pulse driver is connected *directly* to a transmit antenna.



12. Utilization of waveform-adapted UWB pulses, however, became feasible with improved detection techniques, such as that disclosed by applicants' recently issued U.S. Pat. 5,901,172, which in part spurred the development of the present invention. The UWB detecting system provided by the '172 patent is capable of detecting a single UWB pulse. Filtering or band-limiting UWB pulses, though, raises a definitional question about the character of the resulting pulse relative to certain definitions in the industry, i.e., whether it is UWB or simply wideband. In the subject application, applicants' definition of UWB pulses includes pulses having widths of a fraction of a nanosecond (e.g., a few tenths of a nanosecond) to several nanoseconds when emitted at the antenna, it being understood that pulse widths may vary at successive stages between the UWB signal source and the antenna due to signal processing and waveform adapting.

13. While "filtering" UWB signals may have been previously suggested, the industry has been steered away from the development of band-limited UWB systems incorporating filters, pulse shaping, and/or amplification. This is evident by the FCC's recent request from UWB industry participants relative to proposed adoption of UWB guidelines (Notice of Inquiry FCC 98-208 and ET Docket 95-153). ("[F]iltering out some of the energy ... obviously decrease[s] the signal available to the receiver ....," Appendix A). (Filtering at receiver to reject noise, but transmitter filtering is not shown, Appendix B). ("[Restricted bands] would make time-domain systems impossible." Appendix C). ("The insertion of filters ... would so impair the technology as to render it impractical." Appendix D).

Opinion as to Non-Obviousness

14. The examiner should note that a first aspect of the invention claimed in the subject application comprises an UWB transmission system including a low-level UWB source (impulse and/or gated oscillator); a waveform adapter (e.g., a filter, mixer, attenuator, and/or pulse shaper) to select, confine or limit bandwidth or to waveform adapt the UWB signal; and an antenna. A second aspect of the invention further includes an amplifier interposed between the waveform adapter and the antenna. In yet another aspect of the invention, a method or apparatus for modulating the low-level UWB source according to a digital data stream is described. Other aspects of the invention (methods and apparatuses) appear in the recited claims.

15. Based on my experience, qualifications, and the prior art of record and for reasons stated herein, it is my opinion that methods and apparatuses performed or made according the preceding paragraph would not have been obvious to a person having ordinary skill in the art at the time the referenced application was filed. It is also my firm belief that the methods and apparatuses claimed in the subject application, at the time of filing thereof, were not known, or even attempted or reduced to practice by persons of ordinary skill in the art and thus would not have been obvious.

16. In deriving my opinion I have considered the relevant field of art, the scope and content of the prior art in the relevant field, the differences between the claimed invention and the prior art in the relevant field, and the level of ordinary skill in the relevant field of art at the time the invention was made. I am informed that when assessing whether the invention would have been obvious to a person of ordinary skill, I am to consider whether such person would have been able to (i) conceive the invention and/or (ii) reduce the invention to practice, i.e. implement it to a reality, since invention includes both of these steps.

17. In my professional opinion, the field of art relevant includes RF engineering, signal processing, and high-speed digital processing. The content of the relevant art that I took into consideration in arriving at my conclusion includes my personal experience in the field and the prior art of record in the subject application.

18. Based on my experience in industry over the past 27 years, it is my opinion that in the 1996-1997 time frame a person of ordinary skill in the relevant fields of art would have at least a bachelor of science degree in electrical engineering and about 4-6 years of actual work experience in one, and perhaps two, of the RF engineering, high-speed digital processing, and signal processing. It is unlikely that a person of ordinary skill would have experience in each of these disciplines at the relevant time period.

19. I have also personally had the occasion to work with engineers having superior, average and less than average developmental and problem solving skills. I have observed the level of difficulty each has encountered with a variety of tasks in both industrial and academic settings. Based on this personal experience, I am able to opine as to the abilities of a person of ordinary skill (in terms of educational, work experience and abilities to

conceive and reduce engineering practice to reality) in the relevant field of art related to the subject application.

20. In view of differences between the basic structure (and method) of the invention mentioned above and the prior art, the multi-disciplinary skills necessary to reduce to practice the above-stated invention, and the level of skill of a person of ordinary skill to conceive and reduce such an invention to practice, it is my opinion that the basic invention as set forth above would not have been obvious to a person of ordinary skill in the relevant field of art in the 1996-1997 time frame.

All statements made herein on the basis of my own knowledge are true and correct, and all statements made on information and/or belief are believed to be true and correct. I understand that willful false statements are punishable by fine or imprisonment, or both, under 18 U.S.C. §1001 and may jeopardize the validity of the referenced application or any patent issuing thereon.

5/14/99
Date

Robert J. Fontana
Robert J. Fontana, Ph.D.